# Biodiversity Monitoring 24/7
## Hemsworth Farm

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HEMSWORTH FARM LLP

Dorset Wildlife Trust

AgriSound™

AGRIEPICENTRE Engineering • Precision • Innovation

Pollenize

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# Contents



# 1 Introduction

This report considers four different systems for measuring biodiversity and species abundance on a large organic farm in Dorset during 2023. It reviews the methodology and results of each system and assesses the effectiveness of the different approaches. Where possible, comparisons are made and differences between the systems are highlighted before some overall conclusions are outlined. A digital report is also available by request, which provides links to more detailed information.

# 2 Background

40% of insect species risk extinction, and a further 30% are endangered (New Scientist 2019). Farmland comprises 70% of the UK's land area yet few farmers have the necessary tools to actively monitor or quantify on-farm biodiversity, despite it being an important measure of ecosystem, landscape, overall biological health of the farm and a key public good.

These escalating ecological challenges, combined with Government policies devised to address the crisis, such as Biodiversity Net Gain and Local Nature Recovery Strategy, mean that the demand for innovative and effective methods of monitoring wildlife is growing rapidly. There are simply not enough expert ecologists to cover the demand, so the potential of emerging technological solutions has particular importance.

The Hemsworth Project is a collaborative venture, funded through Innovate UK and Defra's Farming Innovation Programme, and led by the farm owner Sophie Alexander and Agri-EPI Centre. During 2023, the project used innovative technology to monitor biodiversity 24/7 on Sophie's 500 hectare, organic dairy and arable farm in Dorset.

Four organisations were involved in the monitoring programme at Hemsworth during 2023. Pollenize CIC used mobile phone technology linked to the iNaturalist online app to catalogue and map biodiversity on the farm. Agrisound provided an automated measurement of pollinator activity at Hemsworth using innovative wing-beat frequency sensors. Chirrup deployed remote acoustic sensors to record farmland bird sounds and relate these to habitat type while Dorset Wildlife Trust provided a more traditional 'walk-over' ecologist-led approach to wildlife survey work.

The project aimed to test and demonstrate the effectiveness of these digital technologies as a means of remotely monitoring biodiversity in the context of a working farm. It was also important to see how the technologies might complement each other and work with the more traditional ecologist-led approach.

"I believe it is important to establish our biodiversity baseline and to continue to monitor progress. There are too few experienced ecologists with sufficient time to manage it all. We are therefore pleased to be involved with testing the data collection capabilities of digital technologies to assist ecologists and in this case, Dorset Wildlife Trust to ground truth the information and demonstrate how an organic farming system can nurture wildlife as well as produce food."

Sophie Alexander, owner of Hemsworth Farm

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# Dorset Wildlife Trust

## Methodology

Dorset Wildlife Trust has been undertaking biodiversity survey work at Hemsworth since 2019 and, so far, over 1,800 species have been recorded on the farm including many which are National Scarce or Rare. Prior to 2019, some informal wildlife monitoring had been carried out by staff and volunteers which suggested that the farm had considerable ecological interest and the owner Sophie Alexander was keen to find out more.

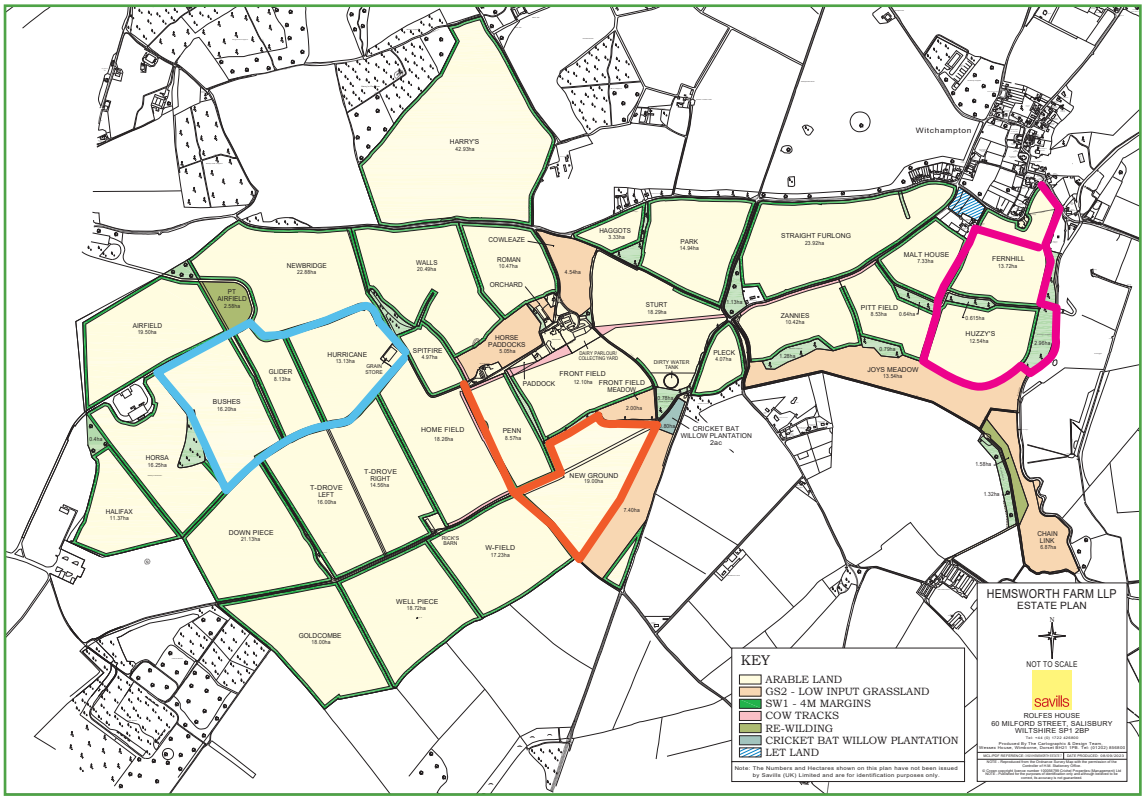
Dorset Wildlife Trust were commissioned to undertake a comprehensive baseline survey of flora and fauna to provide:

- a catalogue of existing species,
- guidelines for future management,
- a baseline from which to measure success of any management changes
- a basis to compare organic agriculture and other types of farming in terms of biodiversity
- information and photographs for communications and media

The survey work is based on three transects which cover different aspects of the farm and include woodland, riverside, hedgerow, arable land, field margins, rewilding areas, wetland areas and calcareous grassland (see map).

In previous years, survey work has been undertaken on a monthly basis between March and October but, to ensure full coverage in 2023, the site was surveyed twice a month during the same period. The 2023 surveys focused on flora and invertebrates (including Orthoptera, Coleoptera, Diptera, Hemiptera, Hymenoptera) and Lepidoptera. Birds, reptiles and mammals are also recorded along the transect line.

## Transect routes



These were primarily 'walk-over' visual and aural surveys, augmented by other basic techniques such as sweep-netting and beating. An adapted DAFOR scale was used to give an approximate measure of abundance. This scale uses the following criteria: Abundant 50+ records, Common 25 - 49 records, Frequent 10 - 24 records, Occasional 6 - 9 records, Scarce 3 - 6 records and Rare 1 - 2 records.

When feasible, surveys were carried out in calm, sunny conditions to optimise the number of species recorded.

When possible, photographs were taken of all species. Many species can be identified in the field but where this proves difficult, photographs were posted on the relevant Facebook groups and other social media to check identification. A network of local and national experts also provided identification advice.

At the end of the survey period, a comprehensive spreadsheet of all species was produced (available on request). This includes relevant information on habitat, site abundance, identification notes and national status.

## Summary of Results

This year's surveys produced 1,787 species, including nearly 300 new species records for the farm. 1,215 insect species were recorded and these included: 22 dragonflies and damselflies, 15 grasshoppers and bush crickets, 194 true bugs, 273 true flies (including 96 hoverflies), 198 butterflies and moths, 157 wasps, 61 sawflies and 104 bees.

Other invertebrates totalled 135 species comprising: 75 arachnids (spiders and harvestmen), 14 woodlice and 46 molluscs.

Vertebrate records included 109 birds and 18 mammals (no specific bat or small mammal surveys) The 310 plant species recorded included 38 Dorset Notables.

The survey work also revealed valuable information about the relationship between biodiversity and habitat type, and the preferences of individual species.

This work highlights the importance of more unusual wildlife habitats such as thistle clumps, nettle patches, track verges, dung heaps and even wheel ruts for enhancing biodiversity.

**18 mammals**

**109 birds**

**135 other invertebrates**

**310 plant species**

**1,215 insect species**

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## Discussion

The fixed transect method is useful in achieving a replicable sample of a limited area of the farm but has its drawbacks in that some potentially bio-rich habitats might not be surveyed. Additional spot-checks away from the transects would be useful.

More accurate information regarding location and time would be helpful possibly using GPS or a similar system. A no-kill policy means examination of specimens in situ and/or from photographs is required and not all specimens can be identified to species level. The abundance scale is somewhat subjective and is intended to give an overall assessment of a particular species' status on the farm rather than an accurate count

Considerable existing expertise and knowledge is required to undertake this type of survey work so this method is less suitable for engaging with volunteers or citizen science than other systems such as Pollenize. This is generally a quick and effective way to gauge a site's biodiversity with most species quickly identified or assigned to a sub-order or genus. The ecological knowledge of the surveyor is also an asset, for instance understanding the relationship between specific insects and foodplants. This knowledge can also provide practical guidelines for habitat management.

As this was the fifth year of Dorset Wildlife Trust's biodiversity monitoring at Hemsworth, the 2023 survey work benefited significantly from the surveyor's previous experience and knowledge of the site. This gave considerable advantage over other systems who had little or no previous experience of the farm.

### Some notable insect species

Hornet Grabber

Tawny Longhorn Beetle

Red Bartsia Bee

# 4 Pollenize CIC

## Methodology

Pollenize is a Plymouth-based company that delivers innovative nature-led remedies that help our pollinating insects, environment and communities flourish.

At Hemsworth, Pollenize used the popular 'bioblitz' approach to measure the site's biodiversity. A bioblitz is a short intensive period of biological surveying in a given area. This method of environmental monitoring builds a picture of biodiversity on a site, informs conservation efforts, and encourages citizen science participation.

Six observers, with limited ecological knowledge, used mobile phones to take photographs of any wildlife that was seen, with an emphasis on plants and pollinators. This included a wide range of species from grasses and lichens to butterflies and bush-crickets. In addition, specific moth trapping was done on a total of 12 nights and this produced a significant number of additional, nocturnal species.

The iPhone photos were uploaded onto the free iNaturalist app. This app uses an online community of naturalists to help identify the uploaded species. It also digitally records the observations with time, date, and location stamps which supports accurate and automated data collection, creating research-quality data for scientists. A Hemsworth project section was created on the iNaturalist site which can be viewed online at https://www.inaturalist.org/projects/hemsworth-farm-master

As an additional feature, the results were analysed by Floradex. Developed with University of Plymouth, Floradex is an AI-powered tracking tool that identifies gaps in the ecosystem and provides solutions to help landowners, developers, and businesses create healthy habitats for pollinators. Further information about Floradex and plant pollinator interactions can be viewed online at https://pollenize1.shinyapps.io/project_page_hemsworth_farm/

Hornet Robberfly

Small Blue

# 4 Summary of Results

An impressive total of 5,062 observations were made at Hemsworth between April and September 2023. For convenience and in the limited timeframe available, most of the observations and photos were collected by 6 Pollenize team members. From these observations, 589 species were identified using iNaturalist and the help of their 343 online identifiers (people who help verify the species)

The species recorded covered a wide range of wildlife from earthworms and dung beetles to lichens and fungi. The number of observations was also recorded on iNaturalist, giving a reasonably accurate idea of abundance. Not surprisingly, plants provided the 50 most frequently observed species with generally common plants such as Creeping Thistle, Hogweed, Dandelion and Yarrow providing the highest number of observations. The most frequent insects were also fairly predictable; Yellow Dung Fly, Large Yellow Underwing, 7-spot Ladybird and Common Carder Bee. At the other end of the frequency scale, 320 species (over 50%) were only observed once.

312 (53%) of all species were plants while 224 (38%) were insects which included 87 (15%) moths and 19 (3%) butterflies. Only 2 bird species were identified and 1 mammal.

The iNaturalist approach does provide recognised verification of records and 95% of Pollenize's records were considered to be 'research grade'.

Although many of the species recorded are generally common in Dorset, there were a few notable exceptions. The tachinid fly Cistogaster globosa is scarce in the county and, although the habitat is ideal and the main host, Bishop's Mitre Shieldbug, is common on the farm, this is the first Hemsworth record. The Large Garden Bumblebee is another rare insect in Dorset as is the impressive Hornet Robberfly. Small Blue butterfly was also a good find. Some of the plants including Hypericum undulatum, Lotus tenuis and Veronica polita are also Dorset rarities. A few records are such as 6-spot Cranefly (only found in Snowdonia and the Lake District) and Invisible Crambid moth (an American species) are considered unlikely but, generally, the vast majority of records seem feasible.

## Map of Observations

# 4 Discussion

The Pollenize method makes use of easily-accessible, existing technologies to create an accurate and verified picture of a site's biodiversity and, in many ways, the Pollenize method is the most similar to the more traditional Dorset Wildlife Trust approach.

A major advantage of the Pollenize approach is the lack of ecological expertise and prior knowledge required to make a meaningful, verified survey. The basic requirement for a surveyor is the ability to use an iPhone and the iNaturalist app. This makes the approach suitable for a wide range of volunteers, farm staff and other non-specialist observers.

Dorset Wildlife Trust recorded 1,793 species while Pollenize listed 589. Interestingly the number of plant species recorded by both systems was very similar; Pollenize 320 and Dorset Wildlife Trust 310 (flowering plants only). However, in other groups, the differences between the two methods was more marked with Dorset Wildlife Trust recording 1,215 insect species compared with 224 on the Pollenize list and 109 bird species compared to only 2.

At the moment, the Pollenize approach is limited by what can be photographed on an iPhone and this is probably a major factor in the low number of bird and mammal species.

Pollenize also concentrated on plants and pollinators at Hemsworth, photographing and recording what was visible on a walkover survey. The Dorset Wildlife Trust survey used additional techniques such as sweep-netting and beating, and this greatly increased the diversity of insects and other invertebrates recorded. However, it would be possible for Pollenize to also use these additional techniques, taking photographs of the resulting invertebrates and uploading to iNaturalist in the same way as other records.

It isn't always possible to photograph insects and other quick moving wildlife so these species will be missed by any approach that relies purely on photography.

The accurate geo-location and time-stamping of records is an important factor in building up an accurate picture of the farm's wildlife. The Dorset Wildlife Trust survey would have benefited from this additional information and this will be investigated further.

Once the basic data has been collected, it can then be used in a wide range of other applications, demonstrated by Floradex which uses Pollenize's information to identify gaps in a site's pollinator potential. This application has great potential but may also identify gaps in recording rather than the actual number of pollinators, for instance the Pollenize survey identified 13 species of hoverfly at Hemsworth compared to 96 on the Dorset Wildlife Trust survey.

**Herbal Ley**

# 5 AgriSound

## Methodolgy

AgriSound is a York-based company that uses fully automated bioacoustic technology to measure pollinator activity on a site. AgriSound's monitoring devices, 'Polly', measure wing beat frequency to detect honeybees and bumblebees in a given area. As part of the project, AgriSound also measured mean temperature and humidity levels at the sensor locations.

At Hemsworth, after careful habitat analysis and discussions with the farm owner, several suitable locations where the devices could be installed, were identified. Factors like crop type, presence of flowering plants, and existing pollinator activity (bee hives) were taken into consideration. When installing the devices, it was important to:

- Ensure that they were securely mounted and positioned to accurately capture data on pollinator activity i.e. at flower height.
- Ensure that the solar panels, used for charging the batteries, had access to sunlight and were cleaned regularly.
- After installation, check the devices to ensure they are functioning correctly and transmitting data as expected.

During the data collection phase, the devices and data were regularly monitored to ensure they were operating optimally throughout the project. This involved AgriSound regularly remotely checking on the device battery health and connection status on the UI and asking Hemsworth Farm to check on any devices where needed.

Once data collection was completed, AgriSound analysed the data to identify patterns in pollinator activity, correlating these with environmental conditions and other relevant factors. A detailed report was generated illustrating a breakdown of the results and identifying the key habitats where pollinator activity was higher. The results and report have been shared with the project partners.

### Deployment Sites

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## Summary of results

The analysis of the data collected revealed that certain habitats exhibit higher abundance of pollinator activity. The top 5 of 12 habitats with higher activity are (these 5 habitats make up 71.3% of total pollinator activity per habitat over the reporting period):

Sanfoin Crop: This habitat shows the highest pollinator activity making up 21.6% of total pollinator activity. The high activity in this habitat could be attributed to the Sanfoin plant, which is known for being particularly attractive to pollinators, especially bees, due to its rich nectar.

Permanent Pasture: 16.6% of total pollinator activity. Pastures, especially those with a diversity of flowering plants, provide a rich environment for pollinators. The variety of flowers and plants in permanent pastures likely contributes to the higher pollinator activity observed.

Herbal Leys: Similar to permanent pastures, herbal leys comprise a mix of grasses, legumes, and herbs. This diversity can support a wide range of pollinators, thus explaining the relatively high activity in these areas, making up 13.3% of total pollinator activity.

Rewilding: 10% of total pollinator activity. Rewilding areas often involve restoring natural landscapes, which can create a favourable habitat for pollinators by providing a variety of native flowering plants and nesting sites.

Wheat and Beans: While not traditionally considered high-value habitats for pollinators, the presence of flowering plants like beans in these crop fields can attract pollinators. The integration of flowering crops with wheat might be enhancing pollinator activity; this habitat collected 9.8% of total pollinator activity.

These findings suggest that habitat diversity, particularly the presence of flowering plants and native vegetation, plays a significant role in attracting and supporting pollinators. Additionally, environmental conditions such as temperature and humidity, which are relatively consistent across these top habitats, also likely to contribute to creating favourable conditions for pollinators.

The correlation between bee activity and humidity, temperature and other environmental factors was also measured (see appendix). This correlation provided a more comprehensive understanding of the factors influencing pollinator activity.

**AgriSound device on site**

# 5 Discussion

The AgriSound approach provided detailed statistical information on pollinator activity which complements the Dorset Wildlife Trust and Pollenize findings. As these results are readily replicable, they could provide a valuable indication of positive or negative changes in future pollinator activity on a farm.

The correlation of pollinator activity with different crops and habitat types also provides useful information that relates directly to farm management. Past studies of herbal leys and field margins at Hemsworth have also demonstrated their particular value for pollinating insects.

AgriSound's findings on habitat preferences correlate strongly with Dorset Wildlife Trust's more subjective observations over the past five years. Not surprisingly, both studies find a strong link between habitat diversity, particularly the presence of flowering plants and native vegetation with the diversity of associated pollinators.

However, it is worth noting that many pollinators rely on a wide variety of plants, particularly at the larval stage. For instance, nettles are well known for being the foodplant for several species of butterfly but are largely wind-pollinated. Many wasps are predatory insects as well as pollinators and it is interesting to note that nearly a quarter of British bees are parasites of other bee species. While AgriSound's habitat analysis considered temperature, humidity and light, other potentially influential environmental factors like wind patterns and floral diversity were not included.

The data collection period was relatively short and did not cover the full pollinator season. A longer study period would have provided more information for understanding changes in pollinator activity over time and in different conditions, seasons, and year on year analysis. The comprehensive pre-installation planning stage ensured that AgriSound installed and positioned the devices correctly, which is crucial for optimal and accurate data collection.

The regular checks made on device battery health and connection status was also vital for maintaining the integrity and continuity of data collection. However, it was felt that increased engagement with farm personnel after the installation phase would have been beneficial, providing more information on crops status and farming practices, and fostering a more collaborative approach to habitat management.

The siting of sensors is critical in assessing pollinator habitat preferences. The extensive field margins at Hemsworth are generally botanically rich and it is important that the sensors are located at a suitable distance from the margins so the sensors can give a true reading for the selected crop or habitat type. The pollinator activity recorded on permanent pasture was surprisingly high and might have been influenced by the proximity of field margins.

As there is no differentiation of pollinator species, there is likely to be a bias at sites where honeybee hives are active. Honeybees were, by far, the most commonly observed bee at Hemsworth by Dorset Wildlife Trust and the second commonest bee in the Pollenize surveys.

The lack of species differentiation also means that AgriSound's results, while giving an accurate measure of overall pollinator activity, are not necessarily a direct indicator of biodiversity especially in an area where there are significant honeybee populations.

The innovative AgriSound system is the most specifically targeted of the three technological approaches and, as such, is the least similar to the traditional ecologist model so making direct comparisons with the Dorset Wildlife Trust results is difficult.

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# Chirrup

## Methodology

Chirrup are a technology company that use specially-designed audio recorders to automatically monitor bird sounds on a farm. This AI-driven application charts the numbers of bird species in an area which, in turn, can provide valuable information about the diversity of insects and plants above ground and the richness of life in the soil.

At Hemsworth, Chirrup used their equipment to carry out a comprehensive bioacoustics survey between the 9-31 May 2023.

Four audio recorders were carefully positioned in various habitats across the farmland, primarily to record the dawn chorus which reaches a peak in May. A fifth (courtesy) recorder was also deployed speculatively at one of the sites for complementary daytime and nocturnal recording. The recordings were saved for analysis with the Chirrup.ai algorithm.

**Corn Bunting**
**Chirrup audio recorder on site**

### Map showing audio recorder placement

# 6 Results

Successful recording took place for the whole 22 day period at each of the four main locations. Unfortunately, the fifth, additional recorder stopped on the 28 May due to battery failure.

A total of 52 bird species was recorded between all sites over this timeframe. These included 10 species on the Birds of Conservation Concern red list with a further 12 on the amber list.

To gain an approximate guide to a bird's level of frequency on the farm, each bird species was assigned a 'species day' number. This equates to the number of days that the sound of species was picked up by one of the acoustic recorders. A threshold was set that each species had to be recorded at least 5 times in a day before it was accepted onto the list. So, if a Linnet was heard at least 5 times on Monday and again on Tuesday that would equate to 2 species days.
Based on species days, the most frequently recorded species at Hemsworth was Dunnock (70 species days) followed by Skylark (69), Wren (66), Goldfinch (62) and Tree Pipit (61). At the other end of the frequency scale, several species, including Jackdaw, Marsh Tit and Buzzard were only recorded on a single day.

The total number of confirmed species recorded during the period was 48 plus another 4 species only logged on the 5th (courtesy) recorder. The number of unique bird species at each recording location ranged from 21 to 34, with the number of Red List species between 5 and 9. Interestingly, although the highest number of species was at Penn and T-Drove Left recording sites, the highest number of Red List species was recorded at Huzzy's. See appendix A for a full breakdown of the species identified.

Following on from the data gathering, the specific feeding niches of detected bird species were investigated. This provided a further insight into the bird's habitat preferences and trophic levels. The bird species were split into 7 distinct groups, based on their primary food source (at least 60% of their diet). The groups were, vertivores, aquatic predators, omnivores, insectivores, granivores, herbivores and aquatic herbivores.

Across all Hemsworth sites, a total of 4 vertivores, 4 aquatic predators, 19 insectivores, 17 omnivores, 4 granivores, 1 terrestrial herbivore and 2 aquatic herbivores were monitored . The percentage composition of each feeding niche varies between sites, with Huzzy's having the highest proportion of insectivores, and T-Drove Left Day and Night having the highest proportion of vertivores. That T-Drove Left Day and Night had the highest proportion of vertivores is a reflection of the nocturnal activity of predator species like owls.

This relationship can be further visualised with the box and violin plots (see digital report) which illustrates the dominance of insectivore and omnivore trophic niche species at Hemsworth.

**Wren**

**Corn Bunting**

**Meadow Pipit**

# 6 Discussion

Overall, Chirrup provided a good overview of the species present at Hemsworth and has demonstrated its value as a remote monitoring system for birds in a farm environment. Apart from a few anomalies in the data which are discussed later, Chirrup is generally considered to be an effective means of comparing the diversity of birds at different farms, and providing a replicable measure to gauge future changes in a farm's bird populations. It is recognised that a single year's recording, condensed into 22 days, can only provide a snapshot of Hemsworth's birdlife.

Based on more conventional bird recording methods at Hemsworth carried out over the past 5 years by Dorset Wildlife Trust, there are a few surprises in the Chirrup results. A small number of species were recorded by Chirrup at a much higher frequency than expected. For example, Tree Pipits have been previously recorded on the farm but as a scarce spring and autumn migrant, usually passing overhead and picked out buy their sharp 'teeze' call. Their Chirrup frequency ranking of 5th with 61 species days is considered unlikely and may be the result of confusion with another species, possibly Greenfinch..

Other species were recorded in lower numbers than might be predicted. There were no recordings of species like Coal Tit, Stock Dove and Green Woodpecker which are all frequently noted at Hemsworth. Other species such as Song Thrush, Wood Pigeon and Meadow Pipit were recorded in lower numbers than suggested by Dorset Wildlife Trust survey work over the last 5 years.

Chirrup have done extensive validation on the recording model used at Hemsworth and were not happy with the accuracy of Reed Warbler, Nightjar and the Common Ringed Plover so these have been removed from any results. Although Reed Warblers are a relatively common breeding species along the River Allen and probably were accurately recorded, it is important that any technology -based companies are prepared to subject their findings to constant checks and review.

The confirmed total of 52 species logged by Chirrup, which includes Marsh Harrier, Tawny Owl, Wheatear, and Great Crested Grebe logged on the day/night recorder, compares with 109 species listed by Dorset Wildlife Trust.

However, the Dorset Wildlife Trust total includes Red Kite, Merlin, Goosander and many other sight-only records. The Dorset Wildlife Trust survey (March – October) period was also much longer than the Chirrup timeframe and encompassed spring and autumn migration when Redstart, Whinchat and other passage migrants were noted. Several winter visitors like Golden Plover, Lapwing, Redwing and Fieldfare were also recorded by Dorset Wildlife Trust.

Chirrup's equipment is stationary and, although in ideal conditions, its range can extend to an impressive 250m, the coverage of the farm is more restricted than a mobile surveyor recording birds on a walk-over survey.

Chirrup provide an additional level of analysis of the birds by trophic niche, confirming the presence of predators of arthropods and vertebrates. For farms interested in encouraging natural pest control, further investigation is needed to fully test the net beneficial impact of these bird species and their trophic relationships with relevant pests and pest predators. In addition, the effect of any direct crop consumption by birds could repay investigation.

As more users join the Chirrup platform, similar farms to Hemsworth will be monitored, enabling data benchmarking between farms, as well as over time. The platform will be developed to further enable information exchange and aggregation between and across farms, as well as allowing qualitative analysis of farm practices.

# 7 Conclusion

The four systems deployed at Hemsworth all performed effectively and produced worthwhile results that could be replicated in future years. The technologies are adaptable and could be deployed in a wide variety of farm locations and other situations.

The three AI-based systems have the potential to complement each other. For instance, the shortage of bird records from Pollenize could be offset by Chirrup's sound recording technology. The pollinator abundance and habitat preference data measured by AgriSound provides hard data which could link to all the systems while Pollenizer's pollinator species information could augment the AgriSound data.

With the experience gained at Hemsworth this year and the ongoing development of AI technologies, there is considerable scope for the remote recording systems to become even more effective in future.

Hopefully, each system has something to learn from the other technologies and approaches. The more traditional Dorset Wildlife Trust survey approach would certainly be improved by additional verification processes, accurate species mapping and better time recording.

The examples of how the collected data from the three technologies can be developed further, highlighted the additional value these systems can generate. These examples included; pollinator gap analysis by Pollenize/Floradex, bird trophic level analysis by Chirrup and pollinator habitat preferences by AgriSound

In the short to medium term at least, it will be still important to have the input of a human ecologist as part of the process. This is necessary to provide an overview and additional context for the collected data. Even a limited analysis of the raw data can highlight what is important, unusual, unexpected or possibly even incorrect. As the technologies develop, there will be increasing scope for them to be used in support of ecologists conducting routine biodiversity surveys.

The Hemsworth Project has been a valuable and successful first step in developing remote biodiversity monitoring on a working farm. As well as providing valuable data, it has also been a learning experience for the participants, and there is considerable scope to develop the project further.

The next stage of the project could further improve the existing technologies, look at different applications and locations for remote monitoring, explore areas for collaborative working, develop analytical tools and create a viable farm monitoring 'package'.

**Brown Hares**

# 8 Gallery of images


Xanthogramma citrofascia-

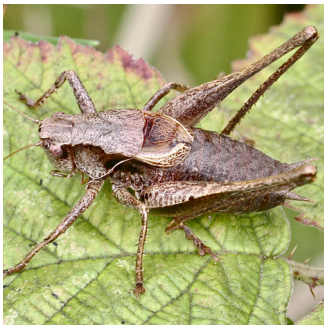

Conops ceriaeformis


Volucella inflata


Odynerus melanocephalus


Erynnis tages


Conops vesicularis


Pholidoptera griseoaptera


Aeshna grandis


Bombylius discolor


Villa cingulata


Phyllopertha horticola


Zootoca vivipara


Halictus rubicundus


Nomada lathburiana


Malacosoma neustria


Buteo buteo


Chorthippus albomarginatus


Falco tinnunculus


Leptura quadrifasciata


Tenthredo scrophulariae

# Biodiversity Monitoring 24/7

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